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NATURAL RESOURCE MANAGER CAPACITY IN THE MURRAY CATCHMENT

2012

ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) was established by the University of Technology, Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human well-being and social equity. We seek to adopt an inter-disciplinary approach to our work and engage our partner organisations in a collaborative process that emphasises strategic decision-making.

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For further information visit: **www.isf.uts.edu.au**

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CITATION

Cite this report as:

Jacobs, B. (2012) Natural resource manager capacity in the Murray Catchment. Institute for Sustainable Futures.

ACKNOWLEDGEMENT

The author acknowledges the assistance of Dr Gill Earl and staff of the Murray CMA in organising and facilitating the capacity assessment workshops and of Nicholas Mikhailovich of ISF in the preparation of the workshop reports.

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20 SEPTEMBER 2012

Natural Resource Manager Capacity in the Murray Catchment

Prepared for: Murray Catchment Management Authority

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EXECUTIVE SUMMARY

Background

Capacity to manage natural resources has many dimensions. It depends partly on the skill and ingenuity of natural resource managers, partly on the resources they have access to, and partly on the institutional and policy environment in which they operate. All these factors become important in assessing capacity, and identifying what enables and constrains effective NRM.

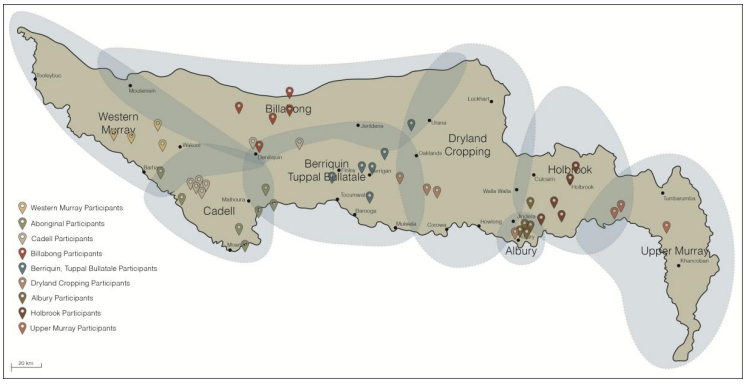
Previous research showed how a Sustainable Livelihoods approach could be used to broaden traditional diffusion of innovation approaches (Rogers 2003) to understanding the adoption of sustainable farming practices by Australian land managers (Nelson et al 2010a). To ensure the regional relevance of capacity assessment, Brown et al (2010) used a facilitated workshop approach with participants drawn from pre-existing networks of NR managers where available. The process entailed asking communities of NR managers to identify aspects (indicators) of the five types of capital (human, social, natural, physical and financial 'assets') that constrained or enabled their ability to manage natural resources, to rate the degree of constraint or enablement of each indicator and to suggest collective actions that might remove the constraint (or enhance the enablement). The aim was to use this list of actions to assist in directing investment of limited funding for NRM into areas where it should be of greatest benefit to NRM outcomes. The process could also assist in prioritising investment and enable monitoring, evaluation and reporting MER on change in regional landholder capacity that results from action to build capacity.

This report aims to conduct a meta-analysis at regional scale of the results of a series of participatory NR manager capacity assessment workshops. The workshops were conducted in 8 social-ecological systems (SES) throughout the Murray Catchment with a diverse range of NR managers. The meta-analysis should identify:

- the existence of widespread constraints to the capacity of NR managers to adopt improved NR management practices throughout the region; and,
- common themes in calls for action by NR managers in the Murray area.

Major findings

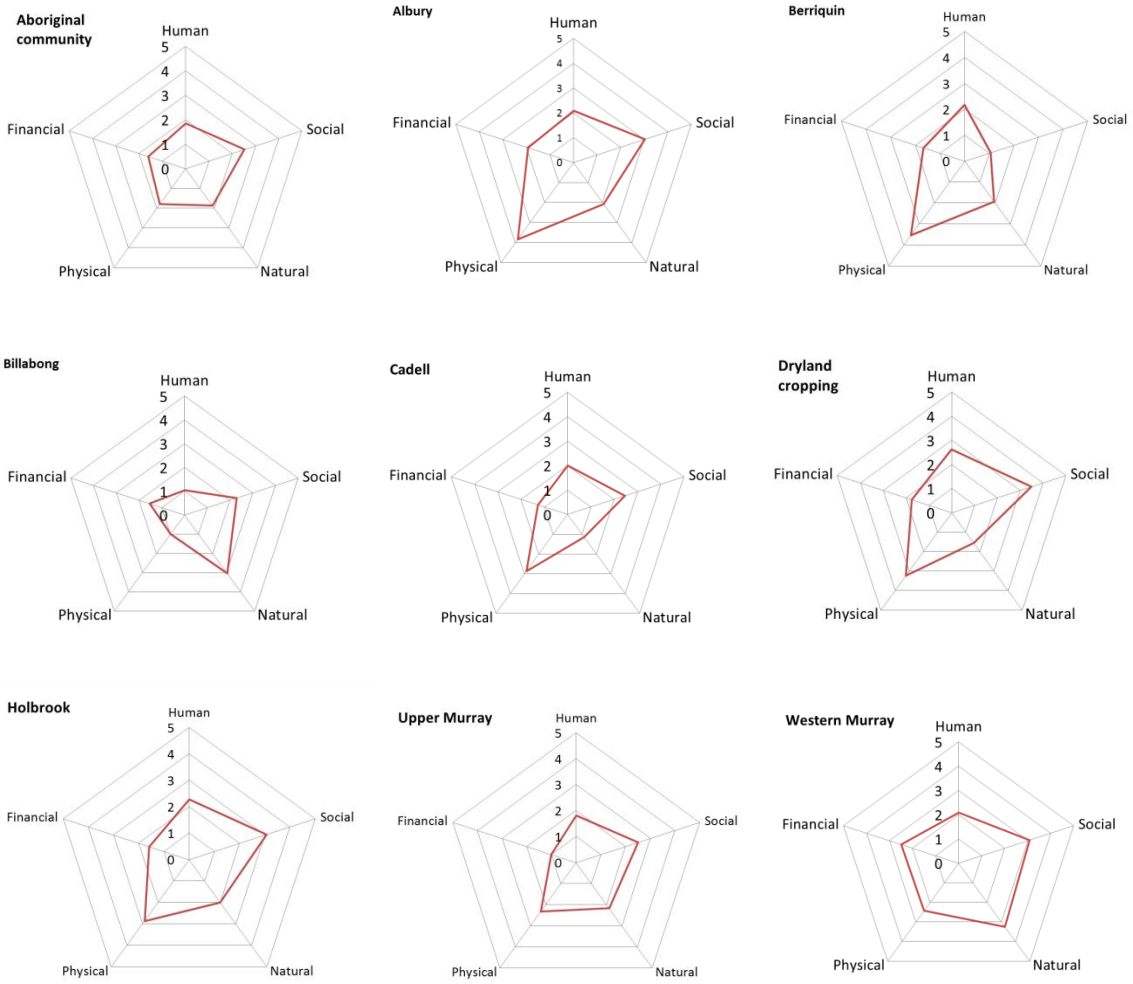
In total, 44 land managers and members of local NRM-based communities participated in the workshops. The key NR manager groups represented in the workshops included large extensive cropping and grazing enterprises, small-scale farming enterprises and life-style blocks, NRM volunteers (such as bush regenerators and Landcare members) and members of a local Aboriginal community.



Map of the social-ecological systems (SES) of the Murray Catchment showing locations from which workshops participants were drawn.

The major findings of the assessment include:

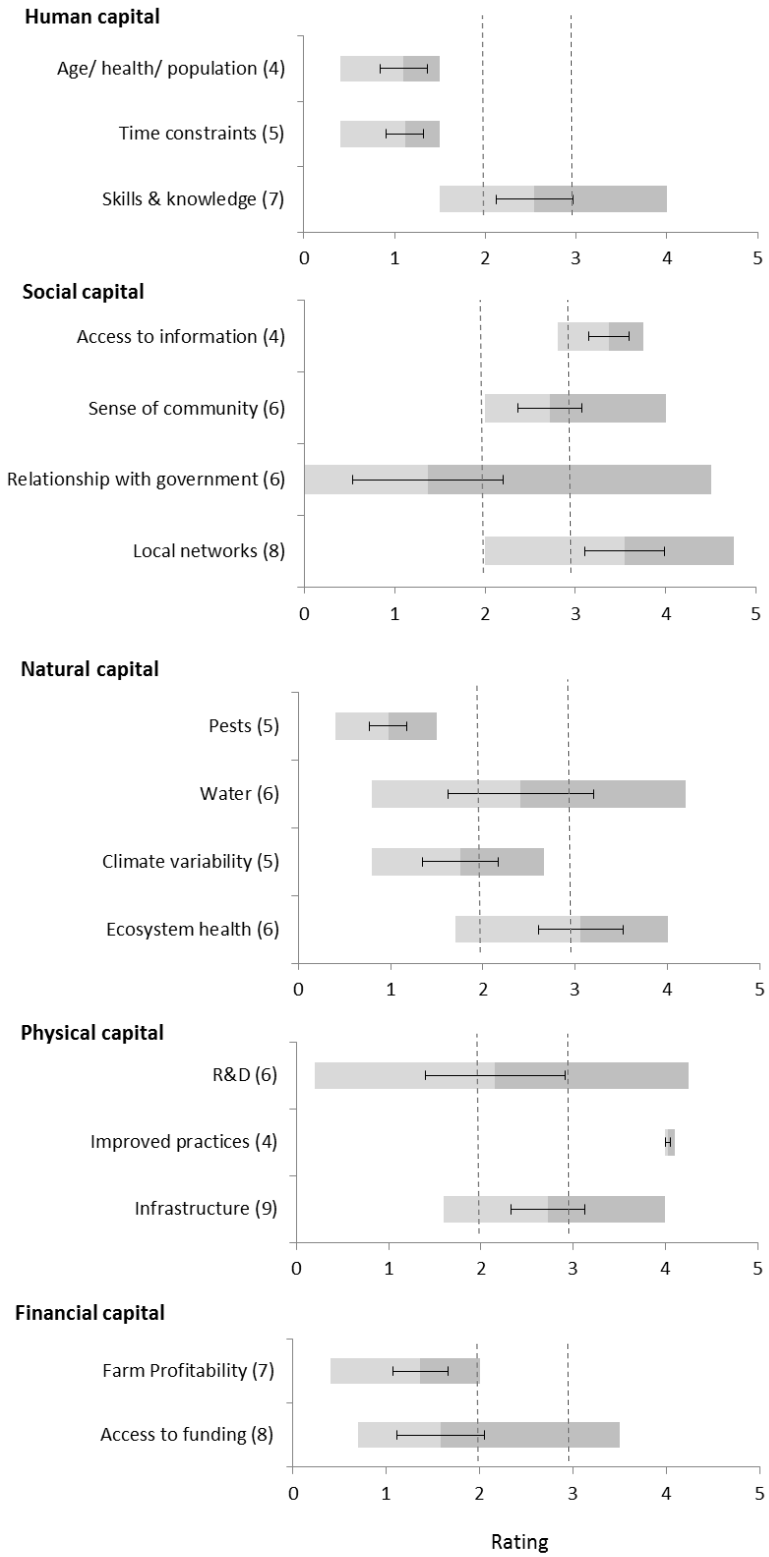
- Ratings of most capitals averaged over all workshop locations were between 2 and 3 and the range of values indicated that they were composed of a mix of constraining and supporting indicators. The exception was financial capital where the average rating of 1.6, the relatively narrow range of values (the minimum and maximum values were 1.1 and 2.5 respectively) and relatively small variation about the mean suggested that it was a regional constraint to effective NRM.
- Livelihood pentagons (see figure below) of the individual workshops illustrated the differences in the ratings of individual capitals at specific locations. Most commonly, social capital supported NRM (5 out of 9 locations), whereas for all locations except Western Murray, financial capital constrained NRM.



Livelihood pentagons from across the Murray Catchment showing self-assessed ratings averaged for each capital.

- In total from the nine workshops, participants identified 41 indicators as either enabling or constraining NRM throughout the Murray Catchment. The figure below shows the indicators that appeared most commonly over all workshops categorised into broad themes by type of capital. Categories of indicators that were identified at the largest number of workshops, with the highest average rating and low variation in rating can be interpreted as supporting NRM at regional scale. Although these indicators operate most widely throughout the Murray Catchment

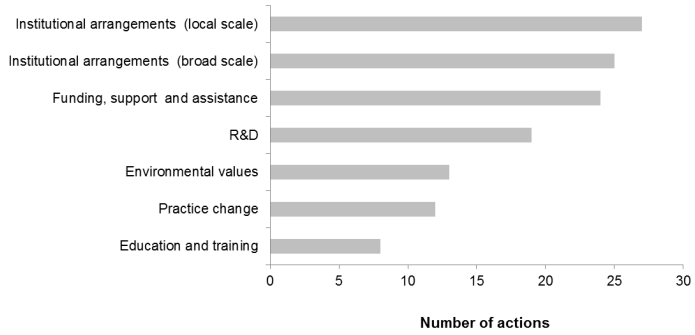
they do not always reflect the factors that most enable or constrain NRM at any single location.



Pooled analysis of the indicators of each of the five capitals. Values (x axis) were the self-assessment ratings for each theme averaged over all workshops and described the degree of support for NRM (0 = constraining to 5 = supporting). The total length of the bar (light and dark shaded regions) shows the range of values for each capital, the junction of the light and dark shaded regions shows the mean

- Workshop participants suggested in excess of 100 actions they considered would remove constraints to NRM (or support enablement). The recurring nature of similar actions across indicators and capitals allowed them to be grouped

arbitrarily into seven broad themes. For the region, in total, institutional arrangements attracted the greatest number of actions. Local-scale institutional arrangements included action to improve aspects of NRM governance, leadership, engagement processes and connections among social networks. At broad-scale they included improvements to infrastructure and services, changes to taxation regimes and regulatory reform.



Pooled analysis of collective actions from all workshops. Actions dealing with common issues were aggregated into seven categories and are presented in descending order of total number of actions.

Recommendation

The regional indicators of capacity should be used to guide formulation of a series of broad goals for the Murray Catchment, derived in accordance with the framework of capitals, for incorporation in the Catchment Action Plan (see table below). The development of goals from information gathered through a bottom-up process, such as the one used in this study, should ensure ownership and broad support for action on NRM that is consistent with community needs.

Goals for the Murray Catchment based on regional indicators of NRM capacity.

Capital	Catchment Goal
Human	Enhance the skills and knowledge of the region's natural resource managers to cope with future biophysical, socio-economic and cultural change in the Murray Catchment.
Social	Maintain and extend the region's strong natural resource networks to improve access to information, build resilient rural communities and engage effectively with NRM policy processes.
Natural	Foster a broader appreciation of the health of the region's ecosystems and work with the region's natural resource managers to enhance the resilience of those ecosystems to variations in climate and threats from pest plants and animals.
Physical	Develop linkages with NRM research and development providers to ensure the region's natural resource managers have access to innovative technology that supports viable farm businesses and improves natural resource outcomes.
Financial	Engage with the region's natural resource managers to develop NRM assistance programs that integrate with local agricultural livelihoods and enhance financial resilience of local communities.

1 INTRODUCTION

Assessing and monitoring natural resource manager capacity attempts to determine the extent to which those who make decisions about natural resources both public and private – including farmers, peri-urban landholders, the mining industry, green-fields developers and local government among others – have the capacity to change their practices to manage these resources more sustainably and be less damaging to the environment (Figure 1).

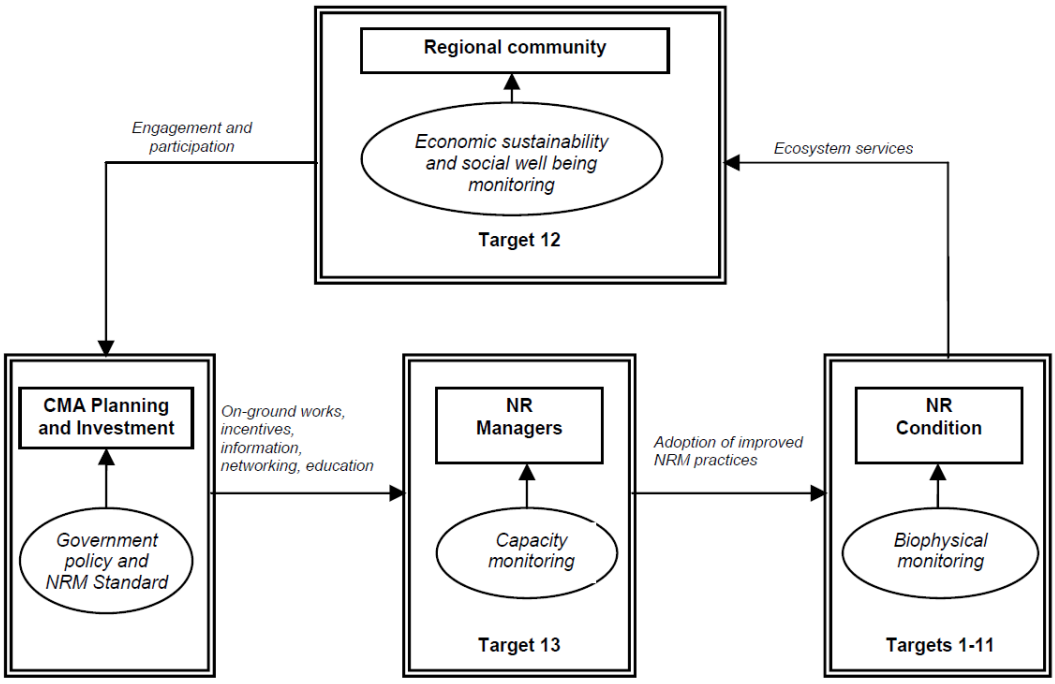


Figure 1: Conceptual model of the relationship between regional communities, Catchment Management Authorities, private natural resource managers and natural resource condition (Jacobs et al 2011)

1.1 SUSTAINABLE LIVELIHOODS APPROACH TO NRM CAPACITY ASSESSMENT

Capacity to manage natural resources has many dimensions. It depends partly on the skill and ingenuity of natural resource managers, partly on the resources they have access to, and partly on the institutional and policy environment in which they operate. All these factors become important in assessing capacity, and identifying what enables and constrains effective NRM. The Sustainable Livelihoods Analysis framework (DFID 1999, Ellis 2000) provides a structure for understanding the interplay of all these factors (Figure 2) because it is integrative, locally-embedded, cross-sectoral and informed by a deep field engagement and a commitment to action (Scoones 2009).

Previous research showed how a Sustainable Livelihoods approach could be used to broaden traditional diffusion of innovation approaches (Rogers 2003) to understanding the adoption of sustainable farming practices by Australian land managers (Nelson et al 2010a). However, national indices of adaptive capacity, such as the one developed by

Nelson et al (2010b), lack the local relevance and community ownership necessary to guide contextually relevant strategies that trigger local action to adopt a change in management practices or mix of livelihood activities.

To ensure regional relevance Brown et al (2010) used a facilitated workshop approach with participants drawn from pre-existing networks of NR managers where available. The process entailed asking communities of NR managers to identify aspects (indicators) of the five types of capital (assets) that constrained or enabled their ability to manage natural resources, to rate the degree of constraint or enablement of each indicator and to suggest collective actions that might remove the constraint (or enhance the enablement). The aim was to use this list of actions to assist in directing investment of limited funding for NRM into areas where it should be of greatest benefit to NRM outcomes. The process could also assist in prioritising investment and enable MER on change in regional landholder capacity that results from action to build capacity.

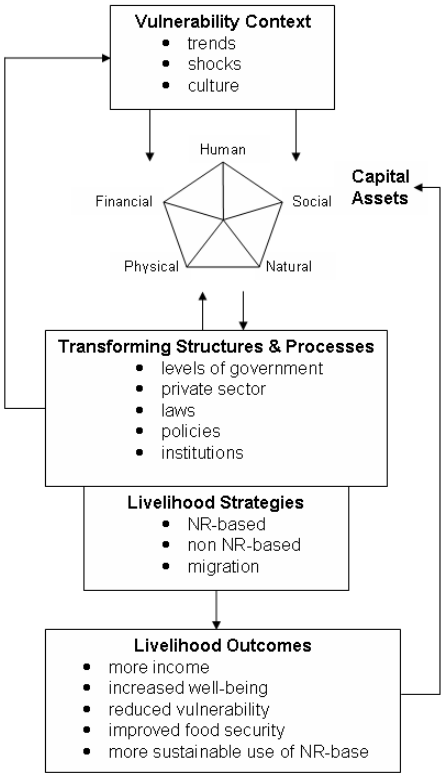


Figure 2: The Sustainable Livelihoods Framework. (Adapted from DFID 1999)

Traditionally, capacity has been described in terms of the knowledge and capabilities of groups and individuals. Views of capacity are often premised on an out-dated perspective of adoption, in which resistance to change is viewed in terms of public knowledge deficits (Pannel et al. 2006, Vanclay 2011). Capacity building has thus been directed at human capital through extension activities such as awareness raising, education and skills development programs (Macadam et al. 2004). Social and other forms of capital have tended to be ignored or under-examined (Marshall, 2009). A more nuanced view of public understanding includes the complex social and institutional drivers of adoption (Vanclay et al. 2009).

1.2 NRM CAPACITY BASELINE

Base-line information on NRM capacity in NSW was reported through a series of catchment scale reports (DECCW 2010a). However, meta-analysis of these reports allowed recurrent themes at wider scale to be identified (Brown et al 2012, Jacobs and Brown 2012, Leith et al 2012; SoE 2009).

The meta-analysis of the State of Catchment reports also examined the collective actions identified by participants to address most of the constraints to NRM capacity (Brown et al, 2012) and assigned these actions to a level of governance most appropriate to implement a process of intervention. Similar actions were often identified to address distinctly different indicators. The recurring nature of similar actions allowed them to be grouped into five overarching activities:

1. institutional arrangements (at a range of scales)
2. education and training
3. extension,
4. funding and assistance, and
5. research and development.

Responsibility for action spanned levels of governance from local to regional to state and national (Figure 3). Many indicators identified capacity limitations inherent in the local community, particularly in relation to human and social capital, that needed to be addressed through action at local and regional scale. Responsibility for action to build financial capital appeared to be viewed as vested primarily in action by state and national governments and largely beyond the scope of local level intervention.

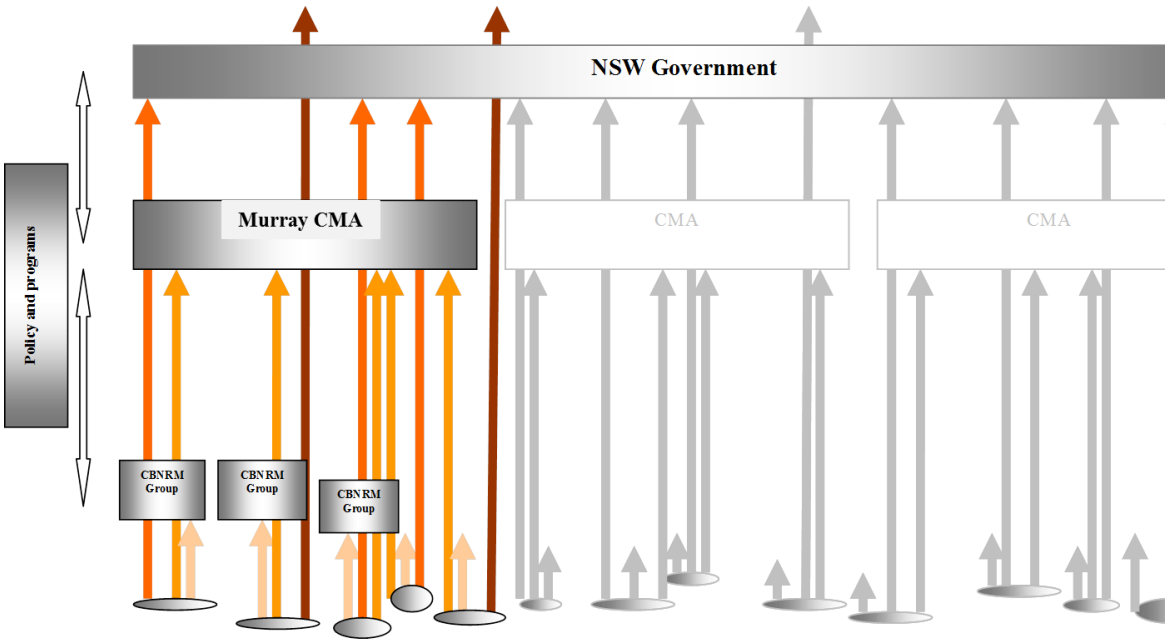


Figure 3: Conceptualisation of the nesting of indicators of capacity and the actions to address capacity constraints identified through the participatory monitoring approaches. Ovals represent individual workshops with geographically discrete groups of NRM managers. Arrows are indicators of capacity targeting particular levels of governance with responsibility for collective action to address the constraint to NRM.

The base-line SoC reporting allowed for the capture of detailed contextual information about individual groups of NR managers at discrete locations and consistently identified broad-scale indicators of resource condition that drive ongoing agricultural adjustment in Australia. However, the number of workshops held in any single region limited both the richness of the information available for detailed assessment at regional scale and the diversity of types of NR managers that could be included in the assessment. These issues are especially problematic in regions where the broad range of actors that influence the management of regional ecosystem services extends beyond agricultural landholders.

1.3 AIMS OF THIS REPORT

This report aims to conduct a meta-analysis at regional scale of the results of a series of participatory NR manager capacity assessment workshops. The workshops were conducted in 8 social-ecological systems (SES) throughout the Murray Catchment with a diverse range of NR managers. The meta-analysis should identify:

1. the existence of widespread constraints to the capacity of NR managers to adopt improved NR management practices throughout the region; and,
2. common themes in calls for action by NR managers in the Murray area.

The results should contribute to the application of resilience thinking in the current round of CMA Catchment Action Plans, particularly in relation to community themes.

2 METHODS

Nine capacity assessment workshops were conducted in the Murray region (Figure 4). Full details of the process are in Brown et al. (2010) and a plain-English summary of the technique can be found on-line at :
http://www.environment.nsw.gov.au/resources/publications/110148NRMBPG.pdf

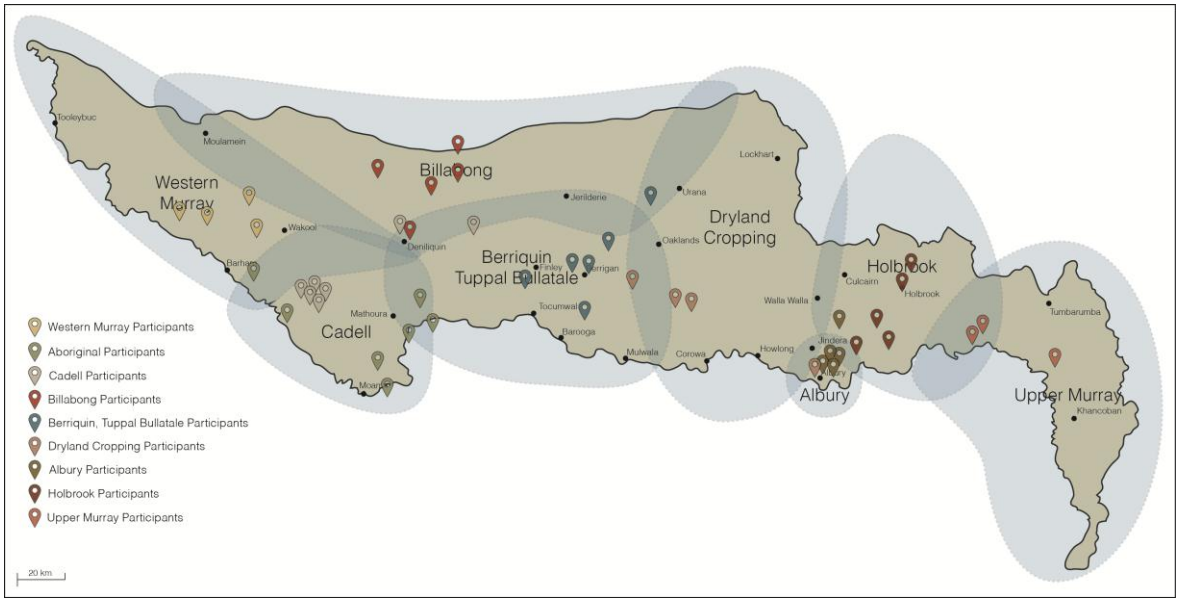


Figure 4. Map of the social-ecological systems (SES) of the Murray Catchment. The symbols indicate approximately the locations of participants' properties or residences and the areas participants were able to knowledgably represent in a capacity assessment. Symbols for the Aboriginal community participants represent some of the public lands associated with their NRM action on 'Country'.

In total, 44 land managers and members of local NRM-based communities participated in the workshops, but many of the individuals who participated represented broader constituencies (for example, some participants represented farmer, industry, or Aboriginal groups) (Table 1). Therefore, representation was potentially much higher. The key NR manager groups represented in the workshops included large extensive cropping and grazing enterprises, small-scale farming enterprises and life-style blocks, NRM volunteers (such as bush regenerators and Landcare members) and members of a local Aboriginal community. Murray CMA staff members were present at the workshops and encouraged to participate in discussions whenever appropriate.

The general process at each workshop involved a brief introduction to the purpose of the workshop, the livelihoods framework and adaptive capacity, a short discussion about the participants role in NRM to establish context, and an outline of the workshop process including selection of indicators, metrics, reason for assigning a particular value to an indicator, and identification of collective actions to improve the indicator.

The initial task of the workshop was to define spatially the geographical area from which the participants were drawn and which they were comfortable to represent (Figure 4).

Table 1: Summary of 9 workshops conducted in the Murray region during August 2012, workshop representation and number of participants. Workshops are labelled according to the SES in which they were held or, for the Aboriginal community workshop, by the location of the venue.

SES	Workshop participant representation	Number of participants
Mathoura – Aboriginal community reference group drawn from the Mathoura-Deniliquin area.	All active in NRM in the western part of the Murray Catchment as government officers working on local national parks or in NRM funding programs, as Murray CMA staff or as community members representing local Aboriginal interests on Country.	5
Albury - NRM professionals and landholders with an interest in the Thurgoona area.	Either local landholders and or professionals in the fields of town planning and urban design, water management, fresh water research, sustainable agriculture or environmental education. Some participants were retired from public service positions, but all remained active in local environmental and NRM groups	6
Berriquin – landholders and extension and community professionals from the Finley area.	Drawn from natural resource managers representing irrigated and dryland farmers and graziers, irrigated dairy farmers, a local extension agronomist, and a community planning officer.	6
Billabong – landholders and local government representatives mainly from the Conargo area.	Represented mixed irrigated and dryland farmers and graziers and a representative of the local shire council. Landholders came from at least third generation farm families and their properties were located mainly to the south of Conargo township	5
Cadell - landholders and local government representatives mainly from the Bunnaloo area.	Represented mixed, irrigated and dryland farmers and graziers (some of whom were also active in local government), and a local government employee in the area of economic development.	5
Dryland cropping – landholders drawn mainly from the area between Corowa and Berrigan and a consultant agronomist.	Represented dryland croppers and graziers, in addition to a local consultant agronomist. Landholders were all active in Corowa Landcare.	4
Holbrook – landholders and Landcare employees.	Representing graziers (sheep and cattle producers), landholders involved in farm forestry and employees of the Holbrook and Mullengandra Landcare groups.	5
Upper Murray – landholders from the Jingellic and Tooma areas.	Representing graziers.	4
Western Murray – landholders from the Barham area.	Representing irrigated rice, dairy and horticulture producers.	4
	Total	44

Facilitated workshop sessions then examined each of the five capitals (Table 2) and the information generated was recorded directly into an ExcelTM spreadsheet which was displayed for participants to view throughout the discussion. Participants were asked to identify indicators that constrained or enabled NRM for each capital, provide a rationale supporting the selection of each indicator, and to assign a score (between 0 and 5) to each indicator where '0' implied that the indicator was constraining natural resource management and therefore is a high priority for action and '5' implied that the indicator was effectively supporting NRM and did not need immediate action. Finally, the reason for the value assigned to each indicator, and collective actions that if implemented would improve the level of support provided by the indicator for NRM, were discussed. A moderation session ensured agreement among participants and provided an opportunity for sense-making. The information was subsequently summarised into written short reports designed to rapidly convey findings to Murray CMA staff and the community committee overseeing the development of the Murray Catchment Action Plan. The reports from individual workshops are included at Appendix A. These reports form the data subsequently used in the meta-analysis reported here.

Table 2: Description of the five capitals framework used in the livelihoods analysis framework of Ellis (2000).

Capital	Definition of capital
Human	The skills, health (including mental health) and education that contribute to the productivity of labour and capacity to manage land and other natural resources.
Social	The family and community support available, and the networks through which ideas and opportunities are accessed.
Natural	The productivity of land, and actions to sustain productivity, as well as the water and biological resources from which livelihoods are derived.
Physical	The infrastructure and equipment, and breeding improvements in crops and livestock that contribute to rural livelihoods.
Financial	The level, variability and diversity of sources of income sources, and access to other financial resources such as credit and savings that available to support rural livelihoods.

The methods used for the regional meta-analysis followed those of Leith et al (2012) and Brown et al (2012) for indicators of capacity and collective actions to address constraints respectively. For indicators, averages of the self-assessment ratings were calculated for each from each workshop and presented as a series of livelihoods pentagons ('spider plots').

Qualitative analysis of recurrent scripts associated with particular NR management roles (eg. Vanclay et al. 2007) and of the storylines (Hajer 1995) relating to how capacity is constrained or enabled allowed indicators to be grouped according to common themes. The frequency of occurrence of indicators in each theme from all workshops and the variation in their ratings facilitates a basic quantitative analysis of factors constraining and enabling landholders' capacity to manage natural resources at a regional scale.

For collective actions, the cumulative number of actions associated with each indicator was used to provide a measure of the diversity of action perceived by participants as options to remove constraint to NRM. Actions were then categorised into seven recurrent activity types being: institutional arrangements (broad-scale), institutional arrangements (local scale), practice change, education and training, funding and assistance, environmental values, and research and development. This categorisation allowed the

interaction between collective action and temporal, spatial and governance scales to be explored.

3 RESULTS

In general, ratings of the capitals averaged over all workshop locations were between 2 and 3 and the range of values indicated that they were composed of a mix of constraining and supporting indicators (Figure 5). The exceptions were financial and human capitals. For financial capital in particular the average rating of 1.6, the relatively narrow range of values (the minimum and maximum values were 1.1 and 2.5 respectively) and relatively small variation about the mean suggested that it was a regional constraint to effective NRM. Among the capitals, minimum values were similar whereas maximum values varied considerably indicating that some capitals, physical and social in particular, were strongly supporting NRM at some locations in the catchment.

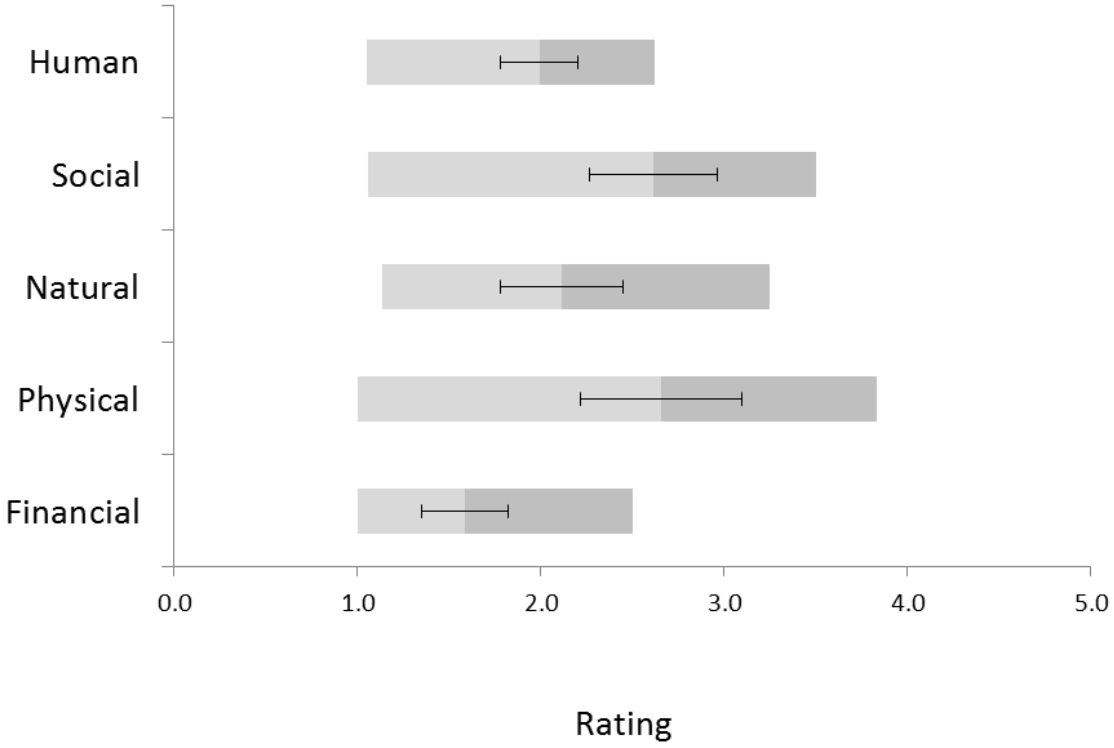


Figure 5: Pooled analysis of average ratings of each capital from 9 workshops in the Murray Catchment. Values (x axis) described the degree of support for NRM (0 = constraining to 5 = supporting). The total length of the bar (light and dark shaded regions) shows the range of values for each capital, the junction of the light and dark shaded regions shows the mean value, and the error bars show the standard deviation about the mean value.

Mean values such as those shown in figure 6, mask large differences in the ratings of individual capitals at specific locations. Livelihood pentagons of the individual workshops provide a useful depiction of which capitals, on average, have the greatest impact on NRM. Locations varied considerably in the number and type of capital constraining NRM. For the Aboriginal community group all capitals except social were constraining NRM. For all locations except Western Murray, financial capital constrained NRM. Natural capital also constrained NRM in the Berriquin, Cadell and Dryland Cropping SES. Human capital constrained NRM at Billabong and Upper Murray. Over all locations, fewer capitals supported NRM (average rating > 3) than constrained it. Most commonly, social capital supported NRM (5 out of 9 locations). The exception was Berriqiun where social capital

constrained NRM. Other capitals that supported NRM were physical capital at Albury, Berriquin and Dryland Cropping; and, natural capital at Billabong.

The reasons for the differences between locations in the average ratings of the capitals lie in the mix of indicators identified by participants as influencing NRM and the individual ratings assigned to them. In total from the nine workshops, participants identified 41 indicators as either enabling or constraining NRM throughout the Murray Catchment. Figure 7 shows the indicators that appeared most commonly over all workshops categorised into broad themes by type of capital. Categories of indicators that were identified at the largest number of workshops, with the highest average rating and low variation in rating can be interpreted as supporting NRM at regional scale. Conversely, indicators with the lowest rating and low variation in rating can be interpreted as constraining NRM at regional scale.

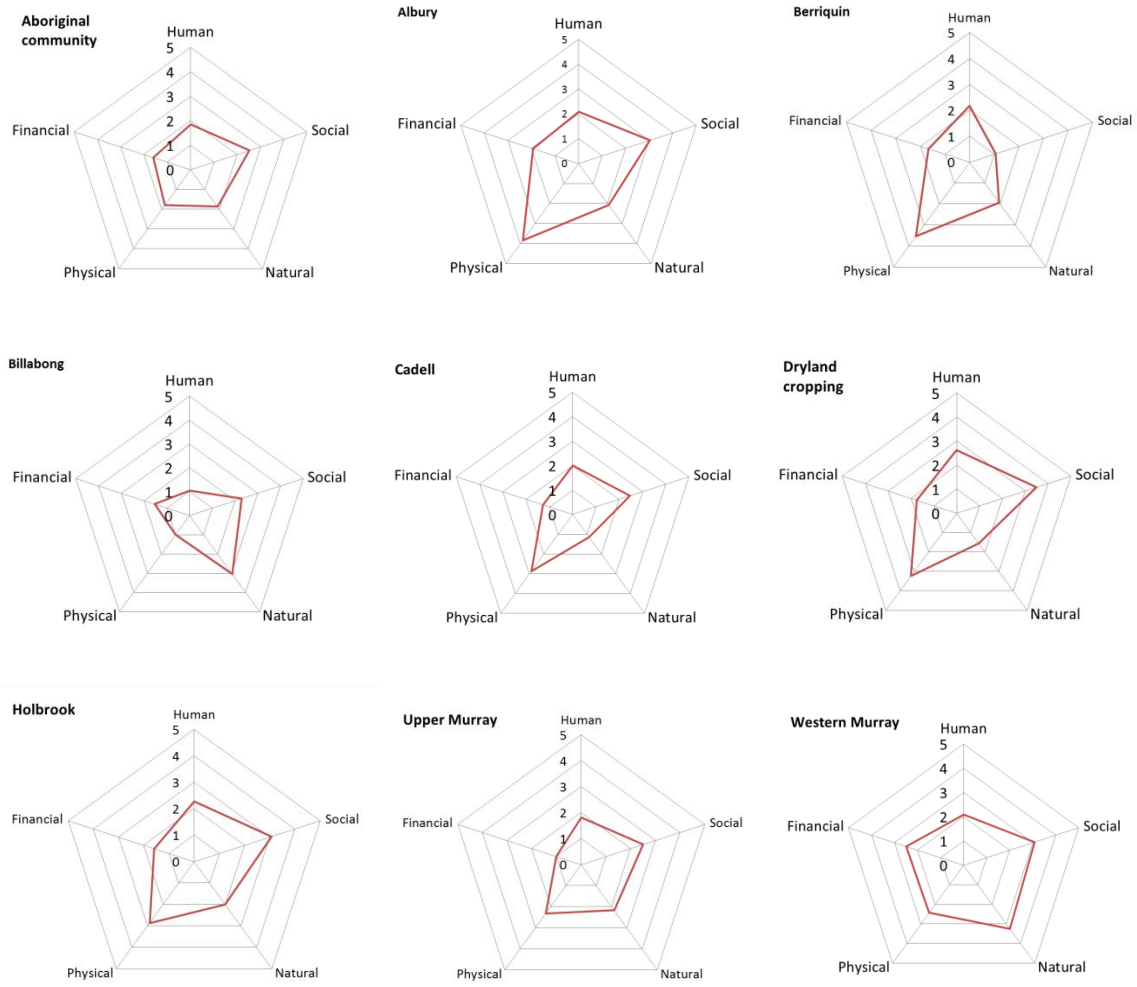


Figure 6: Livelihood pentagons from across the Murray Catchment showing self-assessed ratings averaged for each capital.

For human capital, the complex interaction of *age-health-population* constrained NRM over parts of the Murray catchment because it was identified at four locations, had a relatively low average rating of 1.1, and limited range of ratings over the four workshops. Similarly, *time constraints* limited effective NRM and this indicator was closely linked to the lack of availability of labour (both hired and contributions from family members) to supplement that of landholders. *Skills and knowledge*, while of regional significance to

NRM (identified at 7 locations) varied from constraining to supporting NRM across the catchment. In locations where local NRM and environment groups were most active, *skills and knowledge* most strongly supported NRM.

For social capital, *local networks* among NR managers and *sense of community* generally supported NRM, although the latter was often identified as declining due to drought-induced changes in community structures and demographics. *Access to information*, though less widely identified, also supported NRM. While r*elationship with government* was widely identified as an indicator of NRM capacity, the average rating for this indicator suggested it most often acted to constrain NRM; it was rated variably at locations across the catchment. Generally, in locations where workshop participants were drawn mainly from communities of irrigation farmers fearing the effects on their livelihoods of the Murray Darling Basin Plan (MDBP), relationships with Federal and State Governments were major constraints to NRM. However, in regions where the dominant agricultural activity was dryland farming and grazing largely unaffected by the MDBP, relationships were rated as more supportive of NRM. In addition, at some locations, participants identified relationships with local, rather than State and Federal, government of greater importance to NRM. These relationships were viewed as largely supportive of local NRM capacity.

For natural capital, *pests* (animals and weeds) heavily constrained NRM and were generally considered to be getting worse over time. *Climate variability* was widely identified as an indicator of NRM capacity; however, it was seen as only weakly constraining in most locations because of the current uncertainty over the future impacts on local agro-ecosystems. *Water* (availability and security) was rated variably at six locations. In general, where water was currently available (irrespective of long term security of irrigation) it was rated as supporting a viable agricultural community that could afford to invest in NRM. In other, largely dryland farming and grazing locations it was rated as constraining NRM owing to the carryover of debt from the recent drought, which limited NRM investment on-farm. *Ecosystem health* was widely seen as supporting NRM and increasingly so. At most locations, participants expressed satisfaction with the resilience of local ecosystems in recovering from the drought. In irrigation areas, participants stressed the positive influence of irrigation farming on biodiversity (albeit with a limited focus on birdlife) and the lack of recognition by government and urban communities of the support irrigation provides to NRM, food production and regional communities.

For physical capital, *R&D* and *infrastructure* were widely identified as indicators of NRM capacity. However, the high variation in the ratings for these indicators across the region is largely attributable to the distance of workshop locations from major regional centres and service providers with lower ratings coming from less well serviced or more isolated areas of the catchment. Although identified as an indicator at only four locations, *improved practices* strongly supported NRM. Of all the indicators of regional importance, *improved practices* had the highest average rating and the lowest variation in rating owing to the importance in areas dominated by cropping systems that landholders placed on the benefits of minimum tillage-stubble retention technology for soil health.

For financial capital, *farm profitability* (and other factors related to the viability of agriculture) heavily constrained regional NRM capacity. Most participants volunteered the oft repeated mantra ‘you can’t be green if you’re in the red’ as the reason for the importance of a viable agricultural sector to effective NRM. *Access to funding*, on average, was seen as insufficient to supplement the in-kind contributions to NRM action by farmers, too restrictive in timing and failed to recognise the hidden costs of co-ordinated NRM action (such as administration, communication and organisation). The highest ratings for this indicator occurred where effective Landcare groups had succeeded in attracting funds for local landholders.

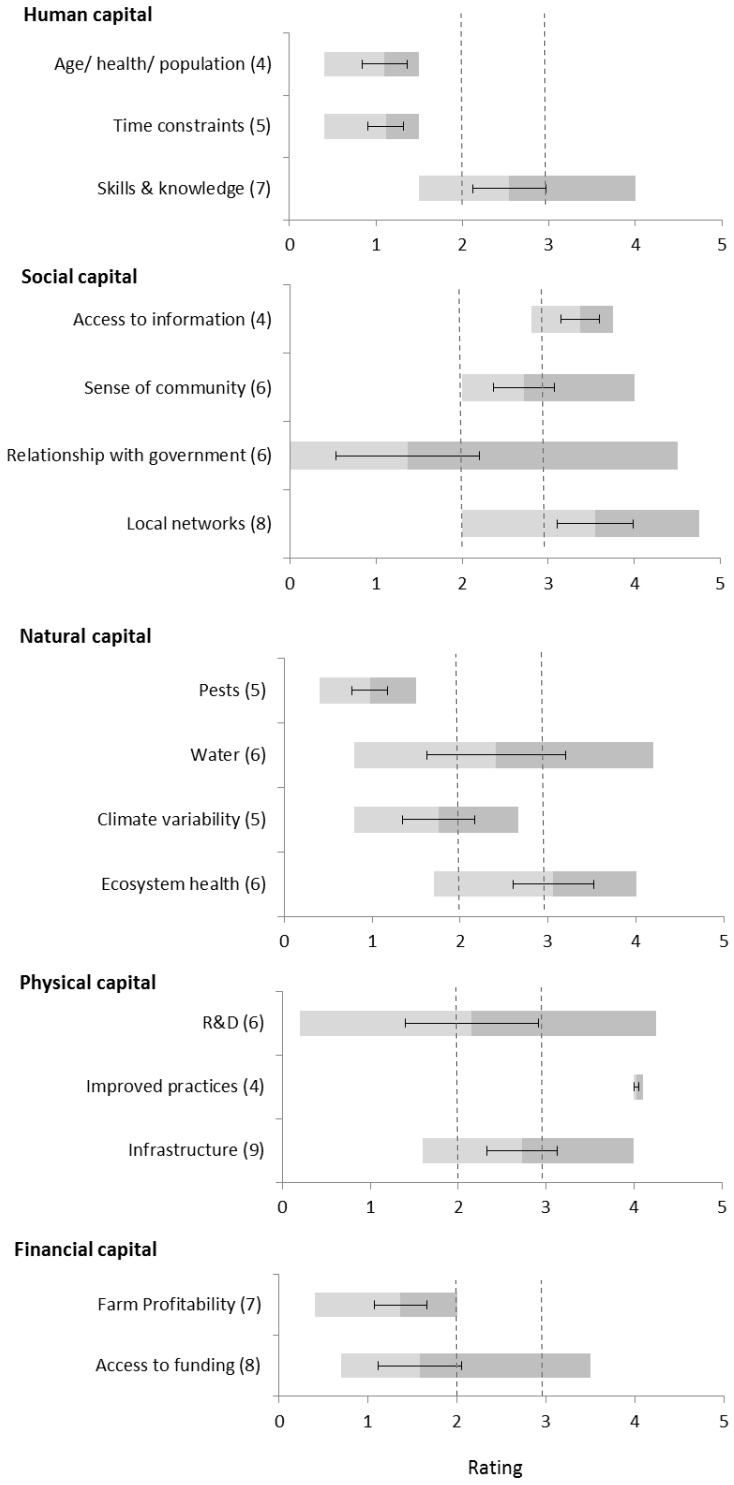


Figure 7: Pooled analysis of the indicators of each of the five capitals. Values (x axis) were the self-assessment ratings for each theme averaged over all workshops and described the degree of support for NRM (0 = constraining to 5 = supporting). The total length of the bar (light and dark shaded regions) shows the range of values for each capital, the junction of the light and dark shaded regions shows the mean value, and the error bars show the standard deviation about the mean value. Numerals in parentheses are the number of workshops at which the indicator was identified as influencing NRM.

The regional priorities in Figure 7 identify a set of indicators of capacity for NRM that operate most widely throughout the Murray Catchment. However, these indicators do not always reflect the factors that most enable or constrain NRM at any single location. Table 3 lists the three most constraining and supporting indicators of NRM capacity from each of the nine workshops. The constraining indicators in this table were drawn from all capitals. In contrast, relatively few of the supporting indicators were drawn from human and financial capitals with most found among the indicators of social and physical capitals.

Almost two-thirds of the ratings assigned to the constraining indicators were perceived to be in decline, whereas over two-thirds of the ratings assigned to supporting indicators were perceived as improving. Some indicators were of regional and local importance to NRM. For example, *relationship with government* was of regional significance and appeared among the indicators most constraining NRM at four locations (Albury, Billabong, Berriquin and Cadell) and most supporting NRM in the Dryland Cropping SES. *Local networks/communication,* also of regional significance, appeared on the list of most supporting indicators in the Billabong, Cadell, Dryland Cropping and Holbrook SES.

Table 3: List of the three most constraining and supporting indicators of NRM and the rating, trend and capital assigned to them at each location throughout the Murray Catchment.

Most constraining indicators				Most supporting indicators			
ARG							
Water - cultural flows	1.2	↑	N	Partnerships	2.6	?	S
Access to Country	1.2	↑	P	Sense of cultural identity	2.6	↑	S
Bush resources	1.4	↑	N	Healthy country /spirituality	3.0	↔	N
Albury							
NRM educational opportunities - farmers	1.5	↓	H	Services	3.7	↑	P
Willingness to learn adapt	1.6	↓	H	Regional centres	3.8	↑	P
Relationship with gov't/ regulations	1.7	↑	S	Infrastructure	4.0	↑	P
Berriquin							
Relationship with Gov't/Regulation	0.3	↓	S	Ecosystem Health	3.7	↑	N
Institutional recognition of local NRM skills & practice	0.8	↓	S	Willingness to learn & adapt /Appreciation of NRM	3.8	↑	H
Water Availability & Security/ Climate Variability	1.0	-	N	Improved Technology	4.1	-	P
Billabong							
Relationships with Gov 't state/federal	0.0	↓	S	Ground Cover/ landscape capability	4.0	↑	N
R&D	0.2	↓	P	Water availability/ Security	4.2	-	N
Labour availability	0.4	↓	H	Local Networks/ Communication/ Local Gov't	4.4	-	S
Cadell							
Relationship with gov't/Regulation	0.4	↔	S	Local networks / communication	3.0	↑	S
Farm profitability & cost of inputs	0.4	↓	F	Sense of community	4.0	↑	S
Climate variability	0.8	↓	N	Improved agricultural practices	4.0	↑	P
Dryland cropping							
Competing demand for land	0.8	↓	N	R&D facilities	4.3	↑	P
Farm Profitability	0.8	↑	F	Relationships with government	4.5	↑	S
Climate Variability	1.0	↑	N	Local networks/ communication	4.8	↓	S
Holbrook							
Support for NRM work	0.8	↓	F	Management culture	3.4	↔	H
Pest plants/ animals	0.8	↓	N	R&D&E facilities	3.4	↓	P
Labour availability	1.0	↓	H	Local networks/ communication	4.0	↑	S
Upper Murray							
Access to government funding	0.7	↓	F	Water availability	3.3	↓	N
Pest plants and animals	1.0	↓	N	Infrastructure - IT	3.7	?	P
R&D facilities	1.0	↓	P	Access to information	3.8	↑	S
Western Murray							
Plant & machinery	1.3	↔	P	Water availability	4.0	↔	N
Time constraints	1.5	↓	H	Improved technology	4.0	↑	P
Farm viability	1.5	↔	F	Diversity of income	4.0	↔	F

Workshop participants suggested in excess of 100 actions they considered would remove constraints to NRM (or support enablement). The number of actions varied considerably with type of capital (Figure 8). Human capital attracted the greatest and financial capital the least number of actions, although both capitals were rated on average as constraining NRM (Figure 6).

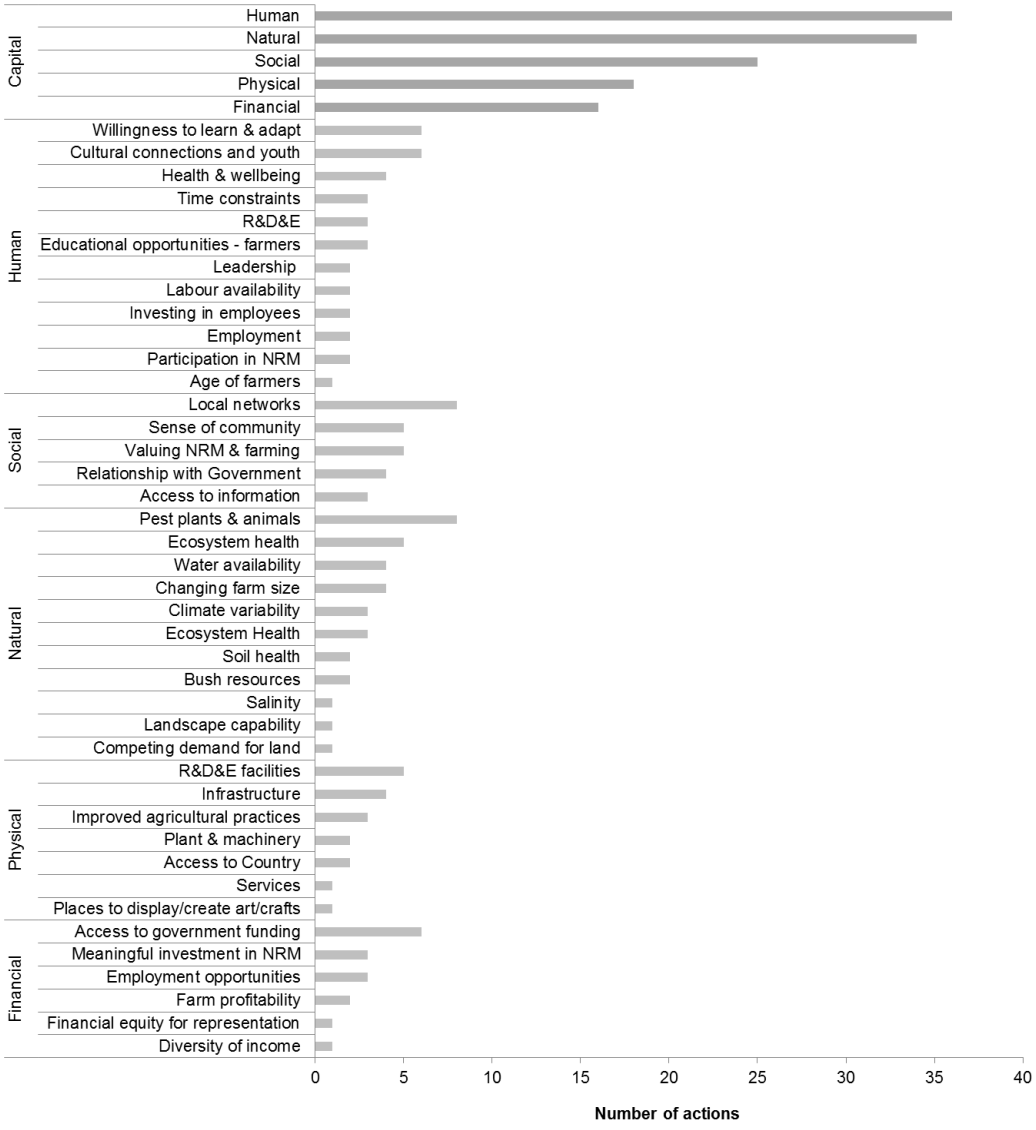


Figure 8: The number actions associated with the major indicator themes of each of the five capitals comprising capacity to manage natural resources as identified by land managers at 9 workshops. Values (x axis) are the number of actions identified to address capacity constraints associated with each indicator.

Similarly, the number of actions associated with indicators within each capital varied widely. Several of the indicators identified as significant to regional NRM, *local networks* (social capital), *pests* (natural capital) and *access to funding* (financial capital) attracted the greatest number of actions.

Many of the indicators of NRM capacity were associated with multiple actions and participants often identified similar actions to address distinctly different indicators. For example, action to improve aspects of incentives for NRM was associated with the following indicators: *access to funding for NRM* and *farm profitability/cost of inputs*

(financial capital), *health and wellbeing* and *time constraints* (human capital), *pests* and *native vegetation and biodiversity* (natural capital), and *improved agricultural practices* (physical capital). The recurring nature of similar actions allowed them to be grouped arbitrarily into seven broad themes (Figure 9).

For the region, in total, institutional arrangements attracted the greatest number of actions. This category was divided into 'local' arrangements at a scale that could be addressed by collaboration among local organisations and social networks without the need for intervention by higher levels of government. This category primarily involved action to improve aspects of NRM governance, leadership, engagement processes and connections among social networks.

Institutional arrangements at broad scale require action by State or Federal Government and included improvements to infrastructure and services, changes to taxation regimes and regulatory reform. Other categories (ranked according to total number of actions) were *funding, support and assistance*, *R&D* (research and development), *environmental values*, *practice change* and *education and training*.

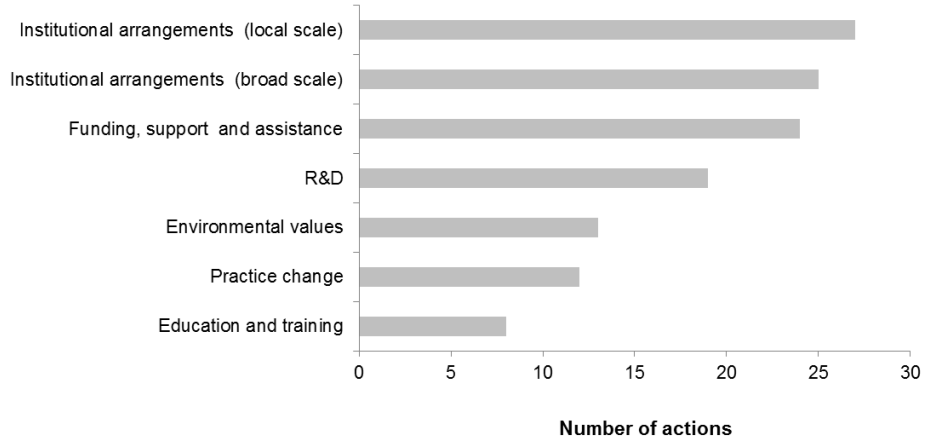


Figure 9: Pooled analysis of collected actions from all workshops. Actions dealing with common issues were aggregated into seven categories and are presented in descending order of total number of actions.

4 DISCUSSION

The findings of the Murray Catchment capacity assessment allow NRM to be viewed from both regional and local perspectives. While the regional findings are important they need to be interpreted in association with individual workshop results to understand the context-specific significance of indicators and capacity building needs among locations or social groups.

The regional indicators of capacity (Figure 7) can be used to guide formulation of a series of broad goals for the Murray Catchment, derived in accordance with the framework of capitals, for incorporation in the Catchment Action Plan (Table 4). The development of goals from information gathered through a bottom-up process, such as the one used in this study, involving close engagement with the community should help to ensure ownership and broad support for action on NRM that is consistent with community needs. Implementation of programs to achieve these catchment goals should aim to result in a shift over time of the degree of support capacity indicators provide to effective NRM in the view of natural resource managers. Clearly, not all of the regional indicators for NRM capacity shown in Figure 7 are amenable to change through CMA action. For example, it is not within the scope of the CMA alone to influence factors such as regional demographic change, climate variability, regional infrastructure or the profitability of agriculture. However, whole-of-government involvement is one of the fundamental guiding principles of the current CAP development process and CMAs have been encouraged to engage widely with all regional stakeholders in their development. It may be possible through co-ordinated cross-agency action to address some of the global issues facing the Murray Catchment. For example, on the issue of climate change, Murray CMA contributed NRM information to the NSW Office of Environment and Heritage's Integrated Regional Vulnerability Assessment, a cross-agency multi-sector assessment of the impact of changes in climate on the provision of government services in the Riverina-Murray that will drive whole-of-government planning for climate adaptation.

Other indicators, such as skills and knowledge, access to information, local networks, local research and access to funding are within CMA responsibilities. Successful capacity building programs should see a rise in the average value of these indicators and a narrowing of the range of values among the region's eight social-ecological systems. For some indicators, it might be possible to implement a benchmarking exercise among SESs to extend learning from one location where, for example, local networks support effective NRM, to other locations in the catchment where NRM is constrained by a lack of networking.

Viewing workshop participants as representatives of social groups rather than of spatial locations reveals significant differences in the way these communities define NRM and their roles in it. For the Aboriginal community group, effective NRM is one part of their connection to Country, which in turn is linked to their identity and well-being as a community. They cautioned that landscape resilience, with its emphasis on maintaining system structure and function, does not necessarily relate to 'healthy Country'. For them NRM intervention should also support spirituality through protection of cultural heritage and by ensuring, for example, indigenous species of local provenance are used appropriately in revegetation programs. Irrigated and dryland cropping farmers view NRM as intrinsic to agricultural production. They identify improvements in NRM closely with the adoption of technology (such as minimum tillage, stubble retention and precision agriculture) that enhances, in particular, the health of soils. Graziers view NRM within the context of improving landscapes and landscape function. For them improved grazing

management to retain groundcover, retention and improvement of native vegetation and strategic tree planting are fundamental to effective NRM. Graziers who were actively engaged in participatory NRM appear to see benefits in these NRM interventions where disengaged landholders do not. The peri-urban community of Thurgoona in the Albury SES view NRM largely as protecting the natural assets of the local area from encroachment from, in their view, inappropriate development of the land motivated by commercial vested interest. An appreciation of how these communities conceptualise NRM is important in tailoring engagement strategies for them.

Table 4: Goals for the Murray Catchment based on regional indicators of NRM capacity.

Capital	Catchment Goal
Human	Enhance the skills and knowledge of the region's natural resource managers to cope with future biophysical, socio-economic and cultural change in the Murray Catchment.
Social	Maintain and extend the region's strong natural resource networks to improve access to information, build resilient rural communities and engage effectively with NRM policy processes.
Natural	Foster a broader appreciation of the health of the region's ecosystems and work with the region's natural resource managers to enhance the resilience of those ecosystems to variations in climate and threats from pest plants and animals.
Physical	Develop linkages with NRM research and development providers to ensure the region's natural resource managers have access to innovative technology that supports viable farm businesses and improves natural resource outcomes.
Financial	Engage with the region's natural resource managers to develop NRM assistance programs that integrate with local agricultural livelihoods and enhance financial resilience of local communities.

The seven categories (Figure 9) into which were placed actions to build capacity suggested by natural resource managers implies a range of roles for Murray CMA that may not all be consistent with past NRM intervention. For example, CMA involvement in action to improve broad scale institutional arrangements implies an active role in advocacy to promote regional interests with State and Federal Governments and could place the CMA in conflict with NSW Government policy on some issues. CMAs should not be expected to operate unilaterally in this space. The evolution of CAPs into whole-of-government strategic planning instruments should assist to focus the attention of regional partners, within and external to government, on resolving such issues. Participants at several workshops called for action to try to change environmental values through better promotion of the region's natural assets emphasising the historical improvements in the region's ecosystem health and the positive role played by rural communities in ecosystem management. Through such promotion participants sought to change the attitudes of urban communities towards regional NSW and thereby influence the views of politicians. While such a campaign is unlikely to succeed, CMA support to better promote the region's

environmental credentials and achievements would probably engender greater reciprocity for other NRM activities among those communities.

An area of concern for Murray CMA is the trend towards disengagement in 'public good' NRM expressed at workshops with irrigators. Irrigators were at pains to explain that while they were active and invested in NRM on-farm they were no longer willing to provide in-kind contributions to achieve public environmental benefits that did not also deliver significant private benefits to their farm businesses and local communities. It is tempting to attribute this attitude to the current round of consultation over the MDBP. However, irrigators appeared to view the MDBP as just the latest in a long series of flawed engagement processes over environmental issues with Federal and State Governments. The disenchantment with and mistrust of higher levels of government is likely to be a lasting legacy among irrigators that could take generational change in the farming community to overcome. Future NRM engagement practice should be informed by the contrasting views articulated by farming communities of local and higher levels of government. Local government, for the most part, was viewed as visible, accountable, embedded in local communities and responsive to local context. State and Federal governments were viewed as remote, ignorant of local context, unresponsive to the needs of local communities and driven primarily by an urban political agenda. The positive sentiment expressed towards the mode of operation of local government supports long-standing calls for the implementation of adaptive co-governance of natural resources to ensure local communities have a meaningful role in the management of the ecosystem services on which their livelihoods depend (Figure 10).

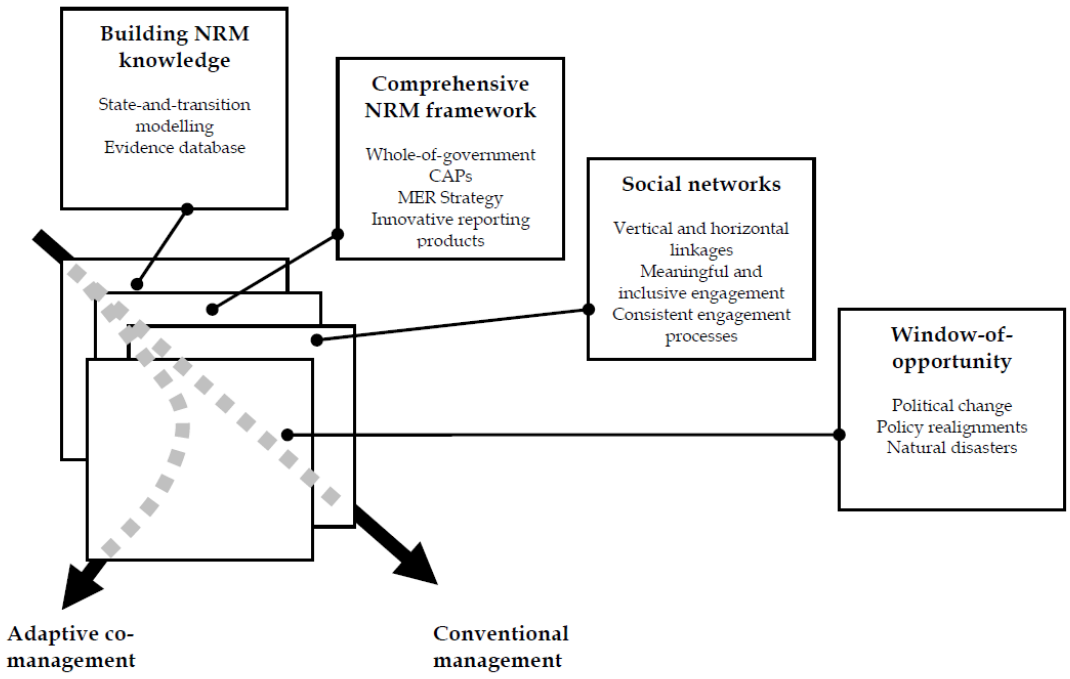


Figure 10. Conceptualisation of the comprehensive framework for defining regional visions and goals for NRM being established through a whole-of-government approach to catchment planning that includes community engagement processes (Jacobs and Brown 2012).

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